

Symmetry analysis of the hadronic tensor for the semi-inclusive pseudoscalar meson leptonproduction from an unpolarized nucleon target

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By examining the symmetry constraints on the semi-inclusive pseudoscalar particle production in unpolarized inelastic lepton-hadron scattering, we present a complete, exact Lorentz decomposition for the corresponding hadronic tensor. As a result, we find that it contains five independent terms, instead of the four as have been suggested before. The newly identified one is odd under the naive time reversal transformation, and the corresponding structure function is directly related to the single spin asymmetry in the semi-inclusive pseudoscalar meson production by a polarized lepton beam off an unpolarized target.

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In the particle physics, the symmetry analysis plays a very important role, since it can forbid or allow for the existence of physical quantities before we set about the details of dynamics. Although the principles and methods involved in the symmetry analysis are usually not complicated, in some circumstances it is a highly nontrivial matter to arrive at a complete result. As the time reversal (\mathcal{T}) invariance of interactions is involved, this is even the case. In fact, most mistakes associated with the symmetry analysis can be traced to the confusion the so-called naive \mathcal{T} transformation with the full \mathcal{T} transformation. In other words, the constraints due to time reversal invariance are often not properly considered.